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Lost in translation

Wednesday, March 04, 2009

Bruce D Malamud and David Petley, of the European Geosciences Union, reflect on the communications issues facing physical scientists working on natural hazards

Financial losses due to natural hazards have increased dramatically over recent years, placing an increasing strain on national and global resources, particularly those in developing areas of the world. The number of scientists and amount of resources committed to natural hazards has also increased, as is illustrated by the surge of scientific conferences and groups worldwide that have a natural hazards focus.

The Natural Hazards Division of the European Geosciences Union (EGU) is one such group, representing possibly the largest annual gathering of scientists researching natural hazards. Attendees are predominantly natural scientists working in academia, but industry and the government are also well represented, as increasingly is the social science community. The EGU has 21 scientific divisions spanning the vast range of the geoscience research field; at the 2008 EGU General Assembly 8,700 participants took part in 504 sessions.

The Natural Hazards division is one of the largest within the EGU; in the 2008 Assembly there were over 1,400 talks and posters presented in over 50 scientific sessions, ranging from extreme weather, lightning, floods, droughts and glacial lake outbursts, to earthquakes, volcanoes, tsunamis, wildfires, karst, heavy-metals, radon and space weather. At the EGU Assembly in 2009 the number of poster and oral presentations in the Natural Hazard division will exceed 1,550, with increased participation from social scientists and the reinsurance industry. However, the Natural Hazard division does more than just participate in the General Assembly; for example, it endorses and sponsors a number of smaller splinter meetings to do with natural hazards, both in developing and developed countries, on a wide range of key themes.

When it comes to the key issues facing the science community with respect to the natural hazards community, there are four major areas of immediate concern to natural scientists.

Communication between natural and social scientists

Over the last two decades there has been a shift in the staffing of aid and associated government agencies from physical scientists (often engineers) to social scientists. This has been reflected also in a transition in the approach taken to disaster risk reduction from one dominated by the natural science paradigm (ie. taking measures to address the hazard) to one dominated by social science (ie. addressing vulnerability). In many cases this has been a positive transition, and it is clear that a move away from an over-reliance on hard engineering solutions was needed.

However, there is an increasing sense of frustration in the natural science community about the perceived lack of evidence to demonstrate the efficacy of social science approaches. The successful reduction in loss of lives from natural hazards in more developed countries has been centred largely upon the use of natural science approaches, in many cases tied to appropriate social processes. One example is determining the probability of various intensities of earthquake shaking, and enforcing building codes that reflect this. The growing sense amongst the natural science community is that less developed countries are being denied this type of approach, instead being forced to accept a social science-based system for which there is little evidence that it works.

We are not arguing that the social science approach is necessarily ineffective; indeed we accept that it may be more effective and efficient. However, at present there are surprisingly few studies that evaluate this properly. At the same time, physical scientists frequently start with the 'science' involved with natural hazards, without thinking properly about the social context or stakeholders within which natural hazards are being studied. This then makes it as difficult for social scientists to understand the natural science approach, or the minutiae of our equations, models, results and arguments.

The reality is that most disasters occur because of complex interactions involving hazardous processes as and social systems. In a sense, disaster risk is a structure that emerges from these interactions. This can be likened to a strand of DNA (Fig. 2); the social system is one strand, the physical system is the other, and they are interwoven and interlinked at all levels. As disaster risks (and thus disasters themselves) emerge from this complex inter-relationship, the only logical way to address disaster risk reduction is to address both elements simultaneously.

Over the years, funding and encouragement to facilitate physical and social scientists to undertake research together, has increased from national and international (eg. EU) agencies. But, there remains a worrying gulf in communication between social and physical scientists, especially in relation to their approaches to risk reduction and particularly ground disaster risk reduction. Wider integration and discussion between physical and social scientists is essential, supported by realistic analyses of the approaches used and their efficacy in different contexts.

Interdisciplinary approaches to research

There is an increasing ethos in the natural hazards community to support and encourage interdisciplinary and multidisciplinary research between physical scientists in a given field (eg. landslides, earthquakes) and those in a cognate area (eg. mathematics, statistics, biology). Although examples can be found in which this has worked well, with the result being greater than the sum of the parts, projects are often constructed to 'bolt' groups together to allow access to specific funds, rather than for genuine reasons. The upshot is that each side does its own research, and then the groups go their separate ways after the grant is finished, with much of the potential untapped and little knowledge transfer between fields.

A key exemplar is the relationship between the natural hazards and the mathematics/statistics communities. The datasets being built in all areas of the natural hazards community cry out for the types of very sophisticated analysis (and sometimes not so sophisticated) that specialised mathematicians and statisticians can, but so rarely do, provide. On the other hand, there are many occasions in which the mathematics and statistics communities are making analyses of natural phenomena without a basic understanding of the ways in which those systems operate. Lack of knowledge transfer is evident in many talks and posters at the EGU General Assembly, where a 'little' knowledge from one community would make a huge difference to the interpretation of the natural hazard being studied.

Potential solutions might include directed short courses that focus on transfer of exchange of knowledge between the communities (large conferences such as EGU might provide the ideal opportunity for such events), increasing funding of online courses to exchange information, and better oversight and analysis by funding bodies for multidisciplinary approaches.

Knowledge to practice

Whilst in recent years there has been a notable increase in the transfer of the results of natural hazards research to practitioners, a large body of work remains locked in the 'academic' literature. This relates to two main issues: the ability and willingness of scientists to generate practical approaches from 'blue-skies' research, and the time it takes to transfer academic ideas to practitioners.

Often, quite rightly, natural scientists undertake 'research' for its own sake – ie. with no obvious direct practical application in mind. In many cases there is little incentive (financial, academic advancement, esteem) for those scientists to convert their ideas or findings into something practical. To a degree this is reasonable – scientists are mostly employed to work on innovative and 'new' science, and often this is what they are best at doing. However, the upshot is that our management of hazards is not as good as it could be. Ideas that are well known in the 'academic' community sometimes take years to be taken up by practitioners. For example, for wildfire burned areas, the academic community has known for the last five or so years that wildfire areas have a frequency-area distribution that is strongly not Gaussian (normal), but this knowledge has not reached wildfire managers who continue to assume that the size distributions are Gaussian. This has implications for risk and the reporting of wildfires.

Thus there is a need to find new ways to exchange information between the science and the practitioner communities. These new mechanisms need to go beyond existing structures, such as knowledge transfer grant schemes. Perhaps the way is being signposted by reinsurance companies, who are increasingly setting up long-term, well-funded and secure collaborative arrangements with academic partners, such as the Willis Research Network. However, the problem of transferring knowledge to practice is particularly acute in the context of developing countries. Although a large percentage of existing natural disasters are in less developed countries, there is depressingly little transfer of science into practice.

Uncertainty

Physical scientists often report (although not often enough), in great detail, the uncertainties involved with their research. But, the concepts, nature and implications of scientific uncertainty are not well understood by policy-makers and/or society. In the press and in government reports, non-scientists tend not to present uncertainties or errors when presenting probabilistic risk, predictions and other models, particularly surrounding natural hazards. This causes confusion when it comes to confidence in the work that physical scientists produce, as non-scientists often do not understand why two models for the same hazard might

give apparently different, or even contradictory, results (as uncertainty is often not expressed). Some excellent work is being done by both individuals and groups on how to communicate scientific uncertainty from scientists to non-scientists, but more, better funded, and larger concentrated efforts are needed urgently.

Some closing thoughts

In concluding this piece, we thought that it would be useful to point out three key dimensions of research in the future:

- Human-induced climate change is undoubtedly important in terms of increasing natural disasters worldwide, but there is a need to remember that it is not the only problem that we face. In particular, for many natural hazards population growth, land use change and urbanisation will also have dramatic impacts on both the occurrence of natural disasters and on the losses that they cause;
- When natural disasters occur, there is often a flurry of activity to investigate the event itself, including the physics of the process and the ways in which it impacted upon the environment and the population. However, scientific interest in the event often rapidly wanes, meaning that there is little information on the long-term impact of the event from both a physical and social perspective. There is a need for far more long-term studies and monitoring of areas, with data being made available to the wider community so that appropriate lessons can be learnt;
- We need to think about the fact that, although the magnitude of global loss of life from natural disasters has been relatively stable for some decades, the number of people affected and the financial loss have both been increasing dramatically over recent years (Fig. 1). Much is being done to address natural hazards, but we need to again ask ourselves, why we are unable to stem these dramatic increases.

Finally, we recognise that there have been many positive trends in the study and communications of natural hazards over recent years. There has been an increased recognition of the importance of disaster risk reduction and of the impacts that disasters have on developing economies, and that the processes that Naomi Klein termed as 'disaster capitalism', in which organisations and even governments use the aftermath of disasters to drive through economic changes that would be otherwise unacceptable to the population, is unhealthy. Science in some key developing countries is rapidly maturing (eg. China, India). The Hyogo Framework laid the foundation for very positive developments. The re-insurance industry has become much more quantitative and scientific over the last few years, driving forward (and often sharing) key developments. Projects such as GEM (the Global Earthquake Model) have the potential to provide open source access to proper risk modelling. The International Charter for Disasters and Space is an excellent initiative (assuming we can get data to end-users on time). Communications technologies have advanced. And, the web is empowering communities (eg. Twitter, YouTube) both for training and the sharing of information.

Overall, there is much to cheer, but far more still to do.